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Calculus, Chaos, and Other Models of Emergency Department Crowding

See related articles, p. 167 and p. 173.

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Two articles on emergency department (ED) crowding in this issue of *Annals* apply scientific rigor to a serious problem in the current practice environment.¹ Schneider et al² sought to pilot the feasibility of using a point prevalence study to assess the degree to which EDs are currently crowded. As an exercise in calculus, the nation's ED bed capacity and emergency staff workloads could be defined as the summation of all data elements in the survey tool used in this study for all points in time for all US acute care hospitals. Even the partial solution to the national calculus of ED crowding offered in this study provides ample evidence that the problem has reached epidemic proportions. Most of us share a sense of urgency with the authors, who rightly view the trends in patient census and staffing as dire threats to the delivery of timely emergency care of uniform quality.

In a related article, Asplin et al³ offer a conceptual model of ED crowding to help researchers, administrators, and policymakers understand its causes and develop potential solutions. The authors deserve credit for defining a framework that could be shared by stakeholders and scientists. The input-throughput-output model they offer recognizes what most of us intuitively know to be true. Hospital-based acute care is a complex set of interdependent systems, many beyond the con-

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trol of emergency physicians, which appear to be increasingly chaotic.

Chaos theory has emerged as a mathematic discipline to model the behavior of living populations and other dynamic systems, such as the elements of the earth's climate.⁴ Nonlinear equations are the norm for living systems, and the conditions under which flow becomes turbulent, or chaotic, have been extensively studied. Graphic solutions to nonlinear equations defining dynamic systems that appear disordered reveal orderly patterns of fractal geometry. Models of ED crowding, where delays are an inherent threat to patient outcomes for a variety of illnesses and injuries, ideally would identify variables and formulas that would predict when orderly patient flow succumbs to crowding. For emergency medicine, there is a better example of chaos theory than the usual beat of butterfly wings in Asia influencing the weather in the Amazon. As Thom Mayer, MD, first pointed out, an emergency physician can confidently predict at the beginning of an evening shift that a critical care bed will be needed by midnight for a patient from the ED. Whether the patient will be a young male adult with penetrating trauma or an elderly woman with a myocardial infarction is immaterial to the emergency physician, but nothing could be more important to the administrator of the hospital.

The Government Accounting Office recently published a study on ED crowding. The federal agency surveyed more than 2,000 hospitals with EDs and found that crowding was most severe in metropolitan areas with larger populations, areas with high population growth, and areas with higher percentages of people without health insurance.⁵ Although the Government Accounting Office noted that no single factor could explain why ED crowding occurs, the inability to transfer ED patients to inpatient beds was found to be the single most common factor. In interviews with respondents, the study also found that hospitals attempt to match staffed beds with revenue rather than licensed capacity. Hospitals also tend to give priority for available beds to scheduled admissions, which are more likely to be used for profitable surgeries and procedures than medical admissions from the ED. It would appear that financial arbitrage by hospitals, or competition

between the ED and other departments of the medical staff for a limited number of inpatient beds, is a leading suspect in the search for root causes of ED crowding. This is supported by the results of a recent study from Schull et al⁶ that found ambulance diversion time was closely associated with the percentage of ED beds occupied with boarders waiting for inpatient beds, but not ED staffing patterns or volumes of ambulatory patients seeking care in the ED.

If hospitals are balancing their books by boarding inpatients in the ED, solutions to ED crowding may have as much to do with market forces as health care policy. Since 1997, visits to EDs have increased by 14% to 108 million annually.⁷ If the acute care delivery system were viewed as an industry, analysts would be celebrating the steady growth in demand as an affirmation of consumer loyalty and underlying value. The problems with ED operations referred to by Schneider et al² and Asplin et al³ would be viewed as challenges for managers. In addition, if market forces were the only ones in play, improved revenues and operating margins would be the inevitable rewards for hospital administrators who best contended with the processes that thwart both consumers and providers of acute care.

Indeed, there is evidence that, when senior hospital leadership commits to solve the problems of ED throughput and output, significant system improvements result.⁸ Adaptation in advanced markets for acute care may also be found in a study from California, where Lambe et al⁹ reported that, as ED visits increased, total ED bed capacity increased, despite the decrease in the number of hospitals with EDs. The study also found from 1990 to 1999, when "market-driven" health care reform dominated California's delivery system, ED utilization declined well below national levels (26.8 visits per 100 persons/year and 37.3 visits per 100 persons/year, respectively).

In reality, acute care markets are perturbed by a mandate on hospitals participating in Medicare that they deliver ED services to all who seek them without respect to the patient's ability to pay.¹⁰ Yet, the Emergency Medical Treatment and Active Labor Act does not place a symmetric requirement on third-party payers to reimburse for the costs of the services being rendered to

their beneficiaries. The financial implications for hospitals extend far beyond ED patients without health insurance. The Government Accounting Office noted that 19 of the 20 most common diagnosis-related groups for Medicare patients being admitted from the ED are for medical conditions that are regarded as less profitable than scheduled surgical admissions.

My own adventures in the safety net lead me to believe that health care politics often trump the efforts of medical scientists to influence health care policy-makers.^{11,12} In that context, election outcomes are far more important than patient outcomes to policymakers. Health care politics can be viewed as a different form of calculus, the summation of all special interests on policymakers at any point in time. ED crowding is only one of many problems that are the unintended consequences of our lack of a coherent US health care policy. There is little reason to expect an imminent resolution of the ongoing US debate as to whether health care is a basic human right or a privilege. However, the first round has already been won: there is general agreement that emergency care is an essential service deserving the protection of the federal government.

The best allies for emergency physicians concerned about ED crowding are undoubtedly ED patients. A recent report from the Institute of Medicine cited by Asplin et al³ points the way for improving the current conditions in the nation's EDs.¹³ Most emergency physicians would agree with the Institute of Medicine that the ideal health care system would be safe, effective, patient centered, timely, efficient, and equitable. Our greatest vulnerability may be that current ED workloads place burdens on emergency physicians, nurses, and support staff that invite unacceptable rates of medical errors.¹⁴ One of the few things more important than profitability for hospitals is demonstrating the delivery of safe patient care to payers and regulators. This suggests studies of ED capacity and processes should concentrate on determining whether crowding predictably diminishes outcomes.

The paradox of ED crowding is that Americans continue to vote with their feet. The steady growth in ED visits despite the current degree of crowding is remarkable evidence that our patients already believe that our

health care sector is the most effective, timely, efficient, and equitable. Emergency physicians seeking to improve on current ED conditions should draw both hope and guidance from the approval of Measure B in Los Angeles County in November 2002.¹⁵ Two thirds of local voters, including property owners, voted in favor of the local initiative, which increased property taxes earmarked for the county's severely underfunded emergency care system. Given the prevalence of ED crowding reported by Schneider et al,² one is left to wonder whether voters in other regions are not equally aware that their own access to emergency care is at risk and ready to support efforts sponsored or promoted by emergency physicians. If health care politics remain based on what one can take rather than what one deserves, the moment may belong to those among us who rise to the occasion.

As daunting as the tasks before clinicians, scientists, and advocates of emergency medicine may be, no better measure of the specialty itself will be found. Within our own hospitals, we must advocate for adequate levels of nurse staffing, ancillaries, and inpatient beds. We must pragmatically implement operating systems that can be shown to make the best use of available resources. We must lend our voices to the many calling for more equitable access to health care coverage. We must vigorously pursue our legal rights to receive timely and reasonable payments from public and private payers. And, if all of our efforts do not eliminate the shortfalls in our delivery systems, we must leverage the respect and trust we have worked so hard to earn in our own communities to create new sources of funding.

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